

PATENT SPECIFICATION

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(54) A METHOD OF PRODUCING SHEET METAL SPRINGS AND DISC SPRINGS PRODUCED BY THE SAID METHOD

(71) We, LUK LAMELLEN UND KUPPLUNGSBAU GMBH., a joint stock company organised under the laws of the Federal Republic of Germany, of Industriestrasse 3, Postfach 1360, 758 Buhl (Baden), Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a method of producing sheet metal springs and particularly, but not exclusively, disc springs such as diaphragm springs, as well as to the springs produced by the said method.

In the case of disc springs, it is known, after stamping, possibly punching and after hardening, to subject the disc springs to a blasting process, such as shot-peening or shot-blasting, in order to produce a strengthening of the material on the surface, whereby the working life of these disc springs or the number of possible load cycles which they will be able to withstand can be increased. According to general experience, an optimum working life is attained if disc springs are blasted with an Almen intensity of A 0.2 to A 0.22 mm, and the degree of surface coverage is as high as possible.

The "Almen intensity" of a shot-blasting or shot-peening operation to which a workpiece has been subjected can be measured by means of an Almen Testing Machine, a machine developed by Mr. J. O. Almen of the Research Laboratories Division of General Motors Corporation. This machine indicates the intensity of the shot-blasting or shot-peening operation to which a workpiece has been subjected in terms of the degree of curvature which is imparted to a standard test piece of given thickness by subjecting one surface of that test piece to a shot-blasting or shot-peening operation identical to that to which the workpiece is or was subjected. The letter A, in the range of

indicates that the standard test piece concerned is composed of cold rolled spring steel, has been heat treated and hardened and held between pressure plates for at least two hours while being maintained at a temperature of 425°C, and which has a length of 76 mm, a width of 19 mm and a thickness of 1.3 mm. The number of millimetres following the letter A, in each case, is the mean height, measured by the machine, of a central point of a small rectangular area of the shot-blasted or shot-peened surface of the test piece above the four corner points of this rectangular area.

It has been found, however, that despite the increase in the degree of coverage in blasting such disc springs, it has not been possible to achieve the increase in their working life, or in the number of load cycles which they must be able to withstand, to render them suitable for many uses.

Accordingly, the invention has for its object to provide an improved sheet metal spring which has a long working life, i.e. is capable of withstanding a very large number of load cycles, as well as an improved method of making such components.

According to the invention there is provided a method of producing a sheet metal spring from a sheet metal stamping, wherein, after the stamping has been hardened, at least one main surface thereof is subjected to a blasting process and thereby roughened by the formation therein of closely spaced indentations and the roughened surface or surfaces are then levelled by a smoothing operation.

The invention also includes sheet metal springs produced by this method.

The smoothing operation may be an electro-chemical smoothing operation, but after it has been heat-treated and has had at least one of its surfaces subjected to a blasting process, to tumbling, barrel finishing or vibratory finishing with a dry or wet abrasive medium. Such tumbling, barrel finishing or vibratory finishing has proved to be particularly advantageous, since not only

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are the projecting peaks of material caused by the blasting process removed, but it is also possible to remove or smooth out those formed by punching or possibly stamping, for example in stamping out the outer edge of the blank or openings therein. In this connection, it may be mentioned that projecting peaks of material may be formed on the outer edge of the blank during the stamping operation, since this operation tends to cause material from the middle part of the thickness of the sheet metal to flow outwardly and thereby form a bulge of irregular contour on the outer edge of the blank.

A particularly advantageous method of producing a sheet metal spring is to carry out the blasting process at a higher intensity than is customary in the production of such parts, i.e. at an Almen value of the order of magnitude of A 0.3 mm and with a lower surface coverage than is usual in the production of parts, i.e. in the region of 70% of the surface.

The working life of sheet metal springs according to the invention, or of sheet metal springs produced by the method according to the invention, may be as much as twice or even more times that of comparable known sheet metal springs or sheet metal springs produced by the method hitherto employed. This may result from the fact that, due to the combined effect of the smoothing operation and the preceding blasting process, which may be carried out at a higher intensity and with a smaller surface coverage than was heretofore customary, not only are the peaks of projecting material removed, but also those contours of the spring, for example the outer contours, are treated which, in the blasting process, have not been treated with sufficient intensity. In addition, the smoothing operation, if effected by tumbling, barrel finishing or vibratory finishing, will contribute towards increasing the fatigue strength of the spring, while the preceding blasting process may also play a part in the removal of the more highly projecting parts of the material.

The invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 shows a diaphragm spring in part elevation, and

Figure 2 is a section on the line II—II in Figure 1.

The diaphragm spring 1 has an annular basic body 2 and radially inwardly directed tongues 3, separated from one another by slits 4. These slits terminate in circular openings 5. After punching and forming the stamped parts 6 on the outer periphery and 7 on the openings 5, the diaphragm spring is brought into its shape for mounting in

known manner and hardened. After being hardened, the diaphragm spring is shot-blasted or shot-peened either in the directions of the arrows VIII in Figure 2, i.e. substantially parallel to the direction of its axis of revolution, or in directions substantially perpendicular to its main surfaces 9 and 10, whereby the fatigue strength of the main surfaces 9 and 10 is increased. This shot-blasting or shot-peening also causes roughened surface parts subjected to impact by the shot. The roughened surface parts are smoothed in a subsequent operation, e.g. by barrel finishing or tumbling in a rotating or vibrating container using either a dry or wet abrasive medium. Any imperfections caused by the punching operation, or bulges formed in the stamping-out of the parts 6 and 7 are thereby eliminated and the fatigue strength of these and other parts which have not been subjected to sufficiently intense impact treatment by the shot during the shot blasting or shot peening operation is also thereby increased.

WHAT WE CLAIM IS:—

1. A method of producing a sheet metal spring from a sheet metal stamping, wherein, after the stamping has been hardened, at least one main surface thereof is subjected to a blasting process and thereby roughened by the formation therein of closely spaced indentations and the roughened surface or surfaces are then levelled by a smoothing operation.

2. A method according to claim 1, wherein the smoothing operation effects the levelling of the roughened surface or surfaces by removing material from between the indentations.

3. A method according to claim 2, wherein the removal of material by the smoothing operation from between the indentations is effected mechanically.

4. A method according to claim 3, wherein the smoothing operation consists in subjecting the sheet metal stamping, which has previously been subjected to the blasting process, to tumbling, barrel finishing or vibratory finishing with a dry or wet abrasive medium.

5. A method according to any of the preceding claims, wherein the blasting process is carried out at an Almen intensity of between A 0.22 mm and A 0.3 mm and with a surface coverage of not more than 70% of the area of the main surface or surfaces subjected to said blasting process.

6. A sheet metal spring produced by the method according to any of the preceding claims.

7. A diaphragm spring substantially as hereinbefore described and as illustrated in the accompanying drawings.

8. A method of producing a diaphragm spring, substantially as hereinbefore described with reference to the accompanying drawings.

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